SCIENCE.

FRIDAY, JANUARY 16, 1885.

COMMENT AND CRITICISM.

THE JOINT committee of the two houses of congress, appointed to consider the relations to each other of the different scientific bureaus of the government, not being ready to report when called upon last December, had its time extended to Jan. 15, and has meanwhile kept its deliberations and conclusions absolutely secret. All that is known is that it has taken a mass of testimony, and that the heads of bureaus concerned have had ample opportunity to render the committee all needful information, and to express their own views, most of which are well known. The committee, as our readers know, asked also the advice of the National academy of sciences (to which body one of its own members, Col. Lyman, belongs); and the text of the academy's report is published by us to-day on another page. We gave, some weeks ago, an intimation of its drift.

The report gives a brief account of the method in which such bureaus are organized in other countries; discusses at some length the character of the work done by the coast and geodetic and the geological surveys, especially in those points where their provinces are similar, pointing out that two distinct and independent trigonometric surveys of the United States are now in process of execution; distinguishes between the military and meteorological work of the signal-service, and recommends their complete separation; indicates the danger of duplication of work by the coast-survey and hydrographic office, but is not prepared to recommend that the latter be detached in any way from the control of the navy department, nor that the hydrographic work of the coast-survey, for over forty years conducted so satisfactorily, be separated from that organization, but suggests the lines on which it thinks the coast-survey should work; lays down the principle that the government should not undertake any work which can be equally well done by the enterprise of individual investigators, and that such work should be confined to what will 'promote the general welfare' of the country; urges the importance of a proper extension of the trigonometrical survey of the United States; and, finally, recommends the establishment either of a department of science, or of a mixed commission of nine members, — two of them scientific civilians to be appointed by the president for six years, two scientific men from the army and navy similarly appointed, three heads of the principal scientific bureaus, together with the president of the national academy, and the secretary of the Smithsonian institution. To the department of science, or to the supervision of this commission, it would transfer the coast-survey, the geological survey, and the meteorological bureau, and, in establishing a physical laboratory, add to it a bureau of weights and measures, the functions of which are now performed by the coast-survey. The province of the proposed commission is amply defined.

No more important measure, affecting the interests of science in this country, has been proposed since the chartering of the National academy of sciences with the functions of an advisory board to government departments. Whether the joint committee, and after them congress, adopt the suggestions of the academy, improve upon them, or utterly discard them, the principle upon which the government should conduct the scientific bureaus which it must of necessity maintain — the principle of proper co-ordination — has been struck; and at some time, if not now, it will prevail. No one who has watched the extraordinary and yet healthy growth of the geological survey since its re-organization five years ago — a re-

organization based upon this same principle, resulting from a recommendation of the same academy — can for an instant doubt the importance of applying that principle to all government work of like character which admits of it. It is not simply that it is the most economical and the most rational, the only scientific principle; but, removing sources of political disturbance, it will allow the natural and healthiest development of our resources, and affect the material advancement of the nation. Ultimately there will be an autonomous and independent department, on a permanent footing, on a level with those of war, state, and treasury, into which will be gathered all the bureaus of original research, of the sciences and industries, and of education, that are not indissolubly connected with already existing departments; as, the mint with the treasury, the hydrographic bureau with the navy, etc. Then we shall wonder why this result was not sooner reached. As it is, each step now tends, directly or indirectly, to that end; and, whatever possible rebuff the principle of co-ordination may meet with at the present time, — and we look for none worse than its oversight through political jugglery, — we may feel confident that it will rise again to the surface.

The precise method of accomplishing the end desired, which the committee of the academy has proposed, — that of a mixed commission of superintendency, — has found a critic before the joint committee of congress in Major Powell, the head of the geological bureau, whose views were given at length before the committee, and are printed in full in this week's issue, though without the discussion to which they gave rise in the committee, this having not yet been made public. Major Powell lays before the committee two fundamental principles which we believe no unprejudiced person, reading his full statement, will be inclined to deny: 1°, that the scientific institutions of the government should be placed under one general management; and, 2°, that the several bureaus engaged in research should be left free to prosecute such research in all its details, without dictation from superior authority in respect to the methods of research to be used. He objects, however, to a commission formed partly of civilians and partly of military men, as composed of incongruous elements, since military and civil methods of administration are entirely diverse, and proceed upon diametrically opposed theories. The military officer plans and commands: the civil officer hears, weighs, and decides. He makes a more forcible objection by showing how delicate the relations of a board composed largely of subordinate officials would be to the different heads of departments, since then the secretaries would simply become channels through which instructions to the very officials composing the board would be transmitted.

All must admit that at least the second of these exceptions is well taken, and it is therefore gratifying to find Major Powell constructive as well as destructive. He proposes that an already existing board should be invested with these new duties; one, too, which is excellently composed, and which would be in some respects more acceptable to the average congressman because chosen in large part by his suffrages, viz., the board of regents of the Smithsonian institution, — a board composed of the chief justice, the vice-president, three members of either house of congress chosen by the presiding officer, and six citizens chosen by joint resolution of congress. This plan would avoid the difficulties pointed out by Major Powell, and has the additional merit that the proposed co-ordination is then carried a step farther, since the institution itself would be under the same control. It would also render the further step to be taken (the creation of a department of science) much simpler, and less beset with difficulties, by removing one of the present chief difficulties in the way of any reform, — departmental jealousies. It is, however, too early yet to discuss this question fairly; for we have not yet before us the full development of Major Powell's proposition,

in the discussions which followed its presentation to the joint committee.

IN A RECENT number of the *Indian gazette*, Dr. Klein, who, with Dr. Gibbes, is now in India investigating the cholera, attempts to throw fresh discredit upon the theory of the specific nature of the comma bacillus of cholera. The grounds for his objections are these. He examined three houses in Calcutta where there had been a severe outbreak of cholera in November. He found the water-supply of all of them good. *Per contra*, at some distance from these houses, and never (?) used by their occupants, were three tanks of water which were swarming with the comma bacilli. The natives in the immediate neighborhood of these tanks used the water freely, and yet were practically free from the disease. Therefore Dr. Klein concludes against the specific nature of the comma bacillus. If this style of *post hoc ergo propter hoc* reasoning is what we are to expect from the English commission, confidence in their conclusions will not be readily given. Koch's position is simply that the cholera bacillus is a necessary condition to the occurrence of cholera, and this latest discovery of Dr. Klein proves nothing against it. It merely seems to show, what has already been granted, that the comma bacillus may be present without the occurrence of cholera. Circumstances favoring its development are, of course, necessary; and a receptive condition of the system must be established in order to its growth, — a fact which is true of all forms of bacteria, so far as they have been observed in relation to pathogenesis.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Coal in the Chico group of California.

THE California geological survey reached the conclusion stated by Professor Whitney in the preface to the second volume on the paleontology of the state, p. xiii., that the Tejon group is the only coal-producing formation in California. In the Proceedings of the California academy of sciences, Mr. J. G. Cooper has recently published a number of notes on the coals of the state. After remarking (vol. v. p. 385) that the Vancouver coal, and others in that region, are undoubtedly of cretaceous age, he states that "there is still some doubt as to those of California, which may be partly or entirely above the cretaceous strata."

Last summer, while engaged in the geological survey of the Cascade Range, a number of fossils were collected from the coal-bearing strata in northern California, eight miles north-east of Yreka, on the road to Linkville, Ore., and south of the cove at the Great Bend of Pit River, where considerable coal has been found. The fossils have been examined by Dr. C. A. White, who reports that they belong to the Chico group, and thus removes the doubt that some of the coal in northern California properly belongs to the cretaceous.

J. S. DILLER.

U. S. geological survey, Washington, D.C.

Man in the stone age.

In a communication to *Science* (v. 3) Dr. Brinton charges me with having forgotten what I read in de Mortillet's 'Le préhistorique.' I am at a loss just how to characterize his quotations from that work, which, like

> "The adventure of the Bear and Fiddle,
> [Begin] but break off in the middle."

De Mortillet wrote (p. 248), "L'accumulation de caractères simiens dans la race de Néanderthal montre clairement que l'homme primitif se rattache aux singes. S'il ne se relie pas directement aux anthropoïdes actuels, c'est qu'il manque entre eux et lui des échelons. Certainement il descend d'une forme ou d'un type intermédiaire. *Nous nous retrouvons donc en présence de l'anthropopithèque, dont j'ai démontré l'existence* (p. 102). Il suffit d'ouvrir les yeux et de regarder pour le voir! Les anthropopithèques se sont montrés, se sont développés et se sont éteints pendant le tertiaire. L'homme a apparu au commencement du quaternaire. Cet homme primitif constitue la race de Néanderthal." Of this Dr. Brinton has chosen to quote only what I have put in Italics. He quotes de Mortillet as saying (p. 339) that the epoch of Moustier 'was characterized by the race of anthropopitheci.' What he actually says is, "L'homme de cette époque devait en majeure partie appartenir à la race de Néanderthal." Again: he says for the epoch of Solutré, de Mortillet "leaves the question open, denying that any traces of man or anthropoid have been discovered (p. 392)." His real language is, "Il résulte de tout ce qui précède que nous n'avons aucun document ostéologique sur l'homme solutréen."

I cannot pretend to be so well informed as Dr. Brinton upon 'the language, religion, and social compacts' of paleolithic man, but I do claim to know something about his *works;* and it is not 'word-splitting' to insist that the magnificent lance-heads of Volgu, in the museum of Chalons-sur-Saône, are quite as much the work of *man, properly so called*, as any 'stemmed scrapers;' nevertheless these belong to the epoch of Solutré.

I am well aware, that, in 1881, de Mortillet chose to substitute the term *chelléen* for *acheuléenne*, which he had suggested nine years previously. But the phrase 'axe of the St. Acheul type,' for the implement peculiar to that epoch, has become too firmly fixed in the nomenclature of prehistoric science ever to be misunderstood; except, possibly, by one who could say that Robenhausen belongs to the 'first epoch of the appearance of man on the globe,' disregarding all the marvellous artistic works of the cave-dwellers of Aquitaine, who belong to the preceding epoch of La Madelaine.

HENRY W. HAYNES.

Boston, Jan. 5.

The use of slips in scientific correspondence.[1]

An account of the 'slip-system of notes' was published by me in the Proceedings of the Boston society of natural history in 1867 (May 15, p. 242), after using it for more than a year. A fuller description is given in Wilder and Gage's 'Anatomical technology' (pp. 45–52). On p. 46 it is said that "slip-notes are of the following kinds: museum catalogues, library catalogues, references, extracts, statements of observations (original or otherwise, with or without drawings)."

During last summer I began to use slips in another way, suggested, perhaps, by the fact that *postal-cards* referring to a single point were frequently filed away with the slip-notes on the same subject. In my scientific correspondence I enclose slips (postal-card size) relating each to a special point. If written closely or with the type-writer, there is usually ample space, not only for the original note, but for an answer to it, if in the shape of inquiry: if not, a second is attached.

As compared with a letter in the usual form, such 'correspondence-slips' present the following advantages: 1. Each point may be attended to by the sender or the receiver independently of others which may require more delay; 2. Without transcription, the slips may be filed with others on the same subject; 3. The same slip, with or without attachments, may be sent back and forth, or to other correspondents, for comment or inquiry; 4. The date of each writing may be affixed, when desirable, either by hand, or by the use of Perkins rubber stamps, or other mechanical device.

As a matter of detail, I may add that I have found it convenient to keep by me envelopes addressed to those with whom I desire to communicate frequently upon matters of common interest, to insert the slips as they were written, and to send the letter as occasion arose.

Among those who have more or less fully co-operated with me in the use of slips in correspondence, should be named, especially, Dr. F. P. Foster, editor of the New-York *Medical journal;* Prof. H. F. Osborn of Princeton college; and my colleague, Prof. S. H. Gage. B. G. Wilder.

Ithaca, N.Y., Dec. 26.

American pearls.

Remembering an inquiry in a back number of *Science* regarding pearls, I thought it perhaps worth recording that small black pearls are not infrequent in the common Venus fluctifraga V. succincta, and V. simillima of this coast. We also occasionally find white pearls in the larger Pachydesma crassatelloides. Haliotis splendens and H. Cracherodii are often pearl-bearers, pearls found in them often being of value and quite pretty. Martesia intercalata buries itself in the shell of Haliotis; and upon boring through, as it often does, the abalone covers the opening with a black, pearly layer, that frequently becomes a large protuberance on the inside of the shell.

C. R. Orcutt.

San Diego, Cal.

The earthquake of Jan. 2.

The earthquake of Jan. 2 was felt distinctly in Washington. Making allowance for the error of my watch, the shock occurred at 9 h. 12.1 m. P.M., eastern standard time, and lasted ten or twelve seconds, accompanied by a rumbling sound, a rattling of windows, and a 'chattering,' jarring, unpleasant sensation communicated from the floor of the room in which I was sitting. The place of observation was about twenty-three hundred feet north-east of the naval observatory. The time may be half a minute in error, either way. William C. Winlock.

Washington, D.C., Jan. 4.

[1] Read before the Society of naturalists of the eastern United States, Dec. 29, 1884.

THE PROSPECTS OF THE NEW PSYCHICAL SOCIETY.

The story of the persecution of Galileo is now familiar to every one. In those days the church had ordained a certain system for the universe, and was disturbed by the discoveries of scientific men. Exactly the same feeling has been shown by two or three scientific men of the present day with regard to the prosecution of investigations of certain so-called psychical phenomena. One of our foremost scientific men has been heard to say, that, if the facts claimed to be true by the committee on thought-transference of the English society for psychical research were true, life would not be worth living. Men of this stamp say that they cannot in any way, or by any proof, be led to believe in the facts; but they would have all study of the alleged phenomena suppressed.

It is very fortunate that men of this 'dark-age' frame of mind are in the minority. Any one who saw the reception among scientific men which was given last summer to Professor Barrett, the emissary of the English society for psychical research, would see how deep-seated is the interest in such investigations, in spite of a healthy scepticism. There is no longer a feeling that such matters can be laughed out of court. As one result of Professor Barrett's visit, at a meeting held in Boston in September, a committee was appointed to consider the formation of an American society on a similar plan to that which Professor Barrett represented. A professorship had already been established in the University of Pennsylvania, and a man appointed to the chair who should devote his time more especially to the study of the physical manifestations known as spiritualism; a late wealthy citizen of Philadelphia having bequeathed a

sum of money for the purpose of testing the truth of the so-called spiritualism.

Since September, the Boston committee has held numerous meetings, and discussed the *pros* and *cons* of the formation of a psychical society, and finally brought forward a constitution under which some eighty gentlemen from different parts of the country have organized themselves. A notice of this meeting was given in No. 100 of *Science;* and in this week's issue we give an account of the completion of the details of organization. It will be seen in this account that the society proposes immediately to begin investigations on thought-transference. It is very necessary that this work should be in the hands of trusty investigators, and that they should have ample opportunity and means for carrying on their work. To some extent, they may find parties in private life who possess the alleged powers, but it may be necessary for them to call upon professionals; and, at any rate, it would be well if they were able to hire the professionals, and subject them to such experiments as would test their capacities. If there is a large proportion of fraud, one of the best works of the society would be to detect it, and publish it to the world; but this it cannot do, unless supplied freely with the necessary funds.

RECENT ADVANCES IN ELECTRICAL SCIENCE.

ELECTRICAL science has not made great strides during the year 1884; but in the direction of practical applications it is feeling the powerful aid of business ability and capital. The U. S. patent office is crowded with applications for patents on various electrical appliances. The scientific investigator must soon make a struggle for the free use of many old and familiar electrical appliances which he has known from boyhood, unless he, too, enters the field as an applicant for patents. The tendency of the times is certainly in the direction of obtaining patents in order to prove priority, even in the direction of pure science. We leave it to the moralist to decide the difference between a copyright for a literary man and a patent for a scientific man.

The problem of electric lighting is gradually yielding to the efforts of the great army of inventors. The Edison company has plants in almost all countries. The incandescent system has made its way on steamboats and steamships. The great Fall-River line of steamboats took the initiative in lighting the steamer Pilgrim, and has now extended the system to the other principal boats of the line. It is said, that, although the cost of lighting by incandescence is double that of gas, the better quality of light and the greater safety from fire counterbalance the increased cost. Experiments have been made by the Weston electric-light company during the year, upon long-filament incandescent lamps, which promise to give lamps approaching the candle-power of many arc-lights with a far pleasanter and steadier light.

Among the methods of electric lighting by incandescence, which have received renewed advocacy during the year, is the battery system. Trouvé's modification of the bichromate-of-potash battery consists in employing a very large proportion of sulphuric acid with bichromate of potash. An experience of three months with this battery will lead its most enthusiastic advocate to long for a cheaper source of electricity.

The problem of electric lighting is to find a cheaper motor than the steam-engine to drive the dynamo-electric engine, or to discover a more direct process of obtaining electricity from heat. No advance has been made this year in the generation of electricity by thermo-electricity. The meetings of the British association at Montreal, and the American association in Philadelphia, did not result in the production of many important papers on electricity; yet there is no doubt that many persons had their ideas clarified and their thoughts stimulated by these meetings. Perhaps the coming year will bear evidence of this. The electrical exposition in Philadelphia showed the great activity in the fields of electric lighting, and was chiefly interesting as an exhibition of various types of dynamo-machines.

The members of the electrical congress, also held in Philadelphia at the time of the electrical exposition, were inclined to dissent from the resolutions of the late Paris congress in regard to the adoption of a hundred and six centimetres of mercury, a millimetre in section, at the temperature of 0° C., as the legal ohm; since the work of Professor Rowland, it was believed, would give a closer value. Professor Rowland has not yet published; but it is believed that results have been obtained which will lead to a revision of the decision of the

Paris conference. The members of the conference also dissented from the conclusions of the Paris conference upon the adoption of the platinum standard of light; and a committee of the U. S. electrical conference is now engaged upon the study of a suitable standard. The suggestion by Siemens to use the light emitted by a square centimetre of platinum at the point of fusion, under the action of a known current of electricity, seems a fruitful one; and the committee is testing its capabilities.

In telegraphy and telephony, there is not much that is new to chronicle. It is perhaps a blow to our national pride to learn that we are behind England in the art of telegraphy, and that we are importing certain telegraphic instruments instead of exporting them.

The London central telegraphic office is certainly not approached in this country for completeness and system. There is a certain analogy between the action of the Irish settler in New England who burns up the fences and cuts down all the wood, and, in short, *skins* the farm, and the action of telegraphic and railroad corporations which run a system, but do not add to it as long as subsistence and dividends can be obtained. The American visitor to the London central office, however, can but be amused, that a separate room, with instruction, is provided for those operators who are to learn the reading of messages by sound. In America it was the operators who taught the superintendents that this method of receiving messages was preferable to the Morse register system.

We learn that the Bell telephone company has lately completed a special line between Boston and New York, and proposes to open telephonic communication between these cities. With the new powerful transmitters that have been and undoubtedly are to be invented, a great increase in the range of telephony is to be expected. Already most of the towns and principal cities throughout New England are connected by telephone-lines, to the great detriment of livery-stables and of stage-lines. The study of this new method of village-communication we leave to the political-economist. The system is destined to work great changes in manners and customs.

Unfortunately, the storage of electricity, so called, does not fulfil the extravagant hopes that were excited when Faure's battery burst upon the world. It is now found that the Planté battery is more practical than the Faure, and that, under careful methods of forming, it gives better results than the Faure and its various modifications. None of the storage-batteries now in use can be said to be commercial successes, for all of them deteriorate seriously in time. To the scientific investigator, however, they are extremely useful. One having a small electrical plant can charge his secondary batteries at his leisure, and thus have on *tap* a steady source of electricity. To the investigator who has ruined many suits of clothes with acid-batteries, and whose hands have almost ceased to be the insignia of gentle birth, the storage-battery is already a great boon.

Much has been said and written upon the subject of the transmission of power by electricity. It is proposed to try different systems upon a certain portion of the elevated railways of New York. Nothing but an experiment upon a sufficiently large scale, under intelligent scientific supervision, can determine whether the electrical transmission of power can compete successfully with the use of the locomotive on public exposed highways. There is a future for this system in many ways, even if it fails on railways. The year, however, has added little to our knowledge of it.

The subject of underground wires has been much agitated lately, and the Western union telegraph company has lately tried the experiment of placing many of its lines between two distant points in Boston under ground. At present they work successfully; but time is needed to show that a suitable degree of insulation can be maintained in this frost-afflicted climate.

The scientific theory of electricity has not received notable accessions during the year. The U. S. signal-service has established stations for the study of atmospheric electricity at Baltimore and at Cambridge. It is believed that electrical observations will give additional data for foretelling the approach of storms. The subject of atmospheric electricity is still shrouded in mystery; and little more is known than that there is a difference of electrical level between the earth and the air, and that this difference undergoes modifications, and that we have methods of measuring these modifications. Little progress has been made in our knowledge of the connection between earth-currents and changes in the electrical potential of the air. It is maintained by Mr. Blavier, who has had several experimental telegraph-lines under his direction in France for the study of earth-currents, that changes in the potential of the air cause very small changes in the character of earth-currents, and that the latter have a real and separate existence.

Lord Rayleigh has been engaged upon a study of the silver voltameter and its application to the measurement of electrical currents. He finds that one ampère deposits four grams of silver per hour, and a sufficient amount can therefore be obtained for accurate weighing in fifteen minutes. Pure nitrate or chlorate of silver gives the best results. Beetz has proposed a new form of Daniell cell, of great internal resistance. Fine alabaster plaster-of-Paris is mixed with concentrated sulphate-of-copper solution, and the copper electrode is fixed in this at one end of a glass tube: the rest of the tube is filled with concentrated sulphate of zinc and plaster-of-Paris, and the zinc electrode is also embedded in this. The ends of the tube are filled with paraffine. This form of cell has been tried at the Jefferson physical laboratory of Harvard university, and has been found an excellent substitute for the water-cell of zinc and copper for charging electrometers.

The lull in the progress of theoretical electricity is probably the precursor of important additions to our knowledge; for many investigators are at work, both at home and abroad, testing the new electrodynamic theory of light, and adding to our knowledge of magnetism. The equipment of physical laboratories in America, which has been one of the features of the year at Cambridge as well as elsewhere in America, bids us hope for much systematic study of the science of electricity, and physical science in general. JOHN TROWBRIDGE.

CO-ORDINATION OF THE SCIENTIFIC BUREAUS OF THE GOVERNMENT.[1]

THE land-maps of European countries are, as a rule, made under the direction of the war departments of those countries, and under the direction of officers of the army specially detailed for that duty, with the aid of experts in the business and in the arts necessary to the surveys and to the production of the charts, who are employed from civil life, and also of enlisted soldiers and non-commissioned officers detailed from the army.

For details on this subject, the committee refers to the printed notes on European surveys compiled and published in 1876, under the direction of one of its members, Gen. C. B. Comstock, U. S. engineers, as the most complete compendium on this subject known to them; also to some manuscript notes prepared by the committee from reports and publications of later date.

[1] Extracts from the report of a committee of the National academy of sciences, consisting of Gen. MEIGS, and Professors J. P. TROWBRIDGE, PICKERING, YOUNG, WALKER, and LANGLEY.

The hydrographic surveys of the coasts of Europe appear in every country to be the work of the naval establishment. On the coasts of the United Kingdom the hydrography has been completed; and now two parties in surveying vessels of the navy are constantly employed in re-sounding and examining channels, harbors, and shoals, in order to correct the existing admiralty charts. All this is done under direction of the admiralty.

While the organization of the land and of the hydrographic surveys in Europe are very perfect, your committee does not find that they offer any thing to improve that of the United States, except, perhaps, in showing the economy in time and money of greater use of photography and of zincography in the reduction and production of maps and charts. In Great Britain now the twenty-five-inch-to-the-mile map is published even earlier than those on smaller scales, all of which are reductions from the original manuscript maps surveyed and plotted on the twenty-five-inch or six-inch scale.

Early and cheap publications of results of operations in the field, if they retain the accuracy of the original maps, are of great industrial and economic importance. The English maps of the ordnance survey are published and placed on sale as soon as printed, and at very moderate prices.

Your committee would call attention, in this connection, to the report made by the National academy of sciences to congress in December, 1878, in which the advantages of a consolidation of the then existing surveys were pointed out. In that report, it was recommended that surveys should be two in number, — the coast and interior survey, to be concerned with the triangulation and mapping of the country and its topography; and a geological survey, to undertake geological and economical investigations. It would be a part of the duty of the former survey to supply the maps for the use of the geological survey; and, in order to secure the co-ordination and harmonious co-operation of the two surveys, it was recommended that the coast and interior survey be transferred to the interior department.

Congress adopted so much of this recommendation as related to the formation of a single geological survey, but did not provide for the proposed transfer of the coast-survey, nor make any other provision for the topographic work necessary for the geological survey. The result has been that these two surveys do not co-operate as they should. The chief of the geological survey has also found it necessary to employ large corps of men in trigonometric measurements.

Your committee does not feel entire confidence that the union of these two surveys under either one of the executive departments, would, without other measures, necessarily lead to that unity of work which is desirable. It therefore recommends certain further legislative measures, the occasion for which will be made clear by a review of the work done by these several organizations; but its members are entirely clear in the opinion that some one of the executive departments should control both. It is for

congress to determine which department shall exercise this necessary authority and control.

The coast-survey was originally organized for the purpose of constructing maps and charts of the coast and harbors for the benefit of commerce and navigation. Conflicting opinions respecting the proper management of the survey led to the formation, in 1843, of a board of officers with the duty of re-organizing the survey. This board submitted a plan which was enacted by congress into law, upon and under which law the survey has hitherto been executed. This plan provided for the co-operation of military officers, naval officers, and civilians in the various parts of the work. Under it the work of the coast-survey has been continued to the present time.

In recent times a great extension of the field of operations of the survey has been made, apparently looking to a triangulation covering the entire territory of the United States. The maps published annually with the report of the survey enable us to know the geodetic work it has executed. It appears, from the maps accompanying the report of 1882, that on June 30 of that year a chain of triangles had been extended throughout the entire length of the Atlantic and Gulf coasts, and throughout about half the Pacific coast. Besides these coast-lines, extensive regions in the interior are seen to be triangulated. In the north-east, the triangulation covers the greater part of the states of New Hampshire, Vermont, and Massachusetts, about half of Connecticut, and it also includes a considerable part of the state of New York.

The reconnoissance has extended westward from the New-Jersey coast, so as to include the greater part of the state of New Jersey, and a long strip in Pennsylvania. From Pennsylvania, the extended line of primary triangulation follows the Allegheny Mountains into northern Alabama, and is now being continued across the country to Memphis.

A triangulation of the Mississippi River was extended from its mouth nearly to Memphis, where it would meet the last-described chain of triangles. The chain connecting the Atlantic and Pacific coasts has been completed nearly across the state of Nevada, and the reconnoissance includes nearly half of Utah Territory. The line is also surveyed at various points in Colorado, Kansas, Missouri, and Illinois. Besides all this, isolated regions in Wisconsin, Indiana, Illinois, Ohio, Kentucky, and Tennessee, have been reconnoitred by the coast and geodetic survey, in a way indicative of a plan designed ultimately to cover the entire territory. As its appropriations for some years past have made provision for the collection of data for a general map of the United States, we may fairly regard the coast and geodetic survey as having undertaken a trigonometric survey of the whole United States.

From the statement of the director of the geological survey, we learn, that, under authority of the annual appropriation bills to prepare a geological map of the United States, that officer has parties engaged in the trigonometric survey of the entire country, which is to be sufficiently accurate for cartographic purposes. It appears, therefore, that two distinct and independent trigonometric surveys of the United States, under two different departments of the government, are now in process of execution.

The meteorological work of the signal-service is divisible into two distinct branches. The first and by far the larger portion of the work is the collection of weather reports from stations in different parts of the union, which are utilized in predicting the probable weather during the twenty-four hours succeeding. Connected with this work is the publication of weather maps, showing at a glance the state of the weather over the entire country at certain moments of absolute time. At the school at Fort Myer, observers and operators are trained for this service. A very important part of its work is the display of signals, and warnings of approaching storms, frosts, and floods.

The other branch of the meteorological service appears in scientific discussions and investigations having for their object the advance of the science of meteorology. These researches are published under the title, 'Professional papers of the signal-service,' which papers consist of memoirs separately paged, and numbered in the order of their issue. Your committee is not informed of the separate expenses of these two divisions of the signal-service, but has no doubt that the expense of the second branch is but a small fraction of that of the first.

The signal-service also performs a military duty, providing the material, and instructing soldiers and officers to communicate between separate bodies of troops by a system of day and night signals; and it also operates and repairs, and when necessary constructs, telegraph-lines for military purposes. The appropriation for these military works and services for the current year is five thousand dollars. In the opinion of the committee, it is desirable that the meteorological work of the weather bureau should be under the general control of the commission proposed later in this paper.

The hydrographic office of the navy department may be considered to date from the year 1848, when the depot for charts and instruments for the navy, authorized by an act approved in 1842, was established. Under this act an observatory was established, and was engaged in the double work of making astronomical observations, correcting chronometers, and of supplying charts to the navy; the establishment being officially styled 'the U. S. naval observatory and hydrographic office.' In 1866 congress authorized the establishment of a separate hydrographic office, to be attached to the bureau of navigation in the navy department, for the purpose of supplying nautical publications and information, not only to vessels of the United States, but to navigators generally. Before that time the functions of the office had been confined to the purchase and distribution of foreign charts. Under the new organization, a drawing and engraving division was established, which constructs charts of foreign coasts and seas for distribution to vessels of the navy, and for sale, at the cost of printing and paper, to navigators gener-

ally. The officer now in charge of the hydrographic office appeared before your committee in person, and gave it a very clear account of the work his office is actually doing.

Besides the hydrographic work of the coast-survey, — which is conducted, and has always been conducted under existing laws, under the direction of the superintendent of the coast-survey, — this hydrographic office is not only supplying corrected charts to the vessels of the navy, but is collecting information as to ice which endangers every ship or steamer of the great lines which connect our northern ports with Great Britain and France; and it also publishes constantly information as to changes in lights and buoys, and discoveries by all nations of shoals and dangers not laid down upon the charts in common use. It publishes at short intervals, not only printed information by bulletin sent to commercial centres in this country, but pilot charts, especially of the North Atlantic, giving the latest intelligence in regard to currents and winds, and the location, when last seen, of all floating wrecks and derelicts, and of the icebergs and other floating ice which through the whole spring, summer, and fall seasons, lie along the eastern edge of the Great Banks, directly in the track followed by hundreds of steamers and sailing-vessels, carrying many thousands of travellers, passengers, and immigrants, and the millions of dollars of our exports and imports.

This work of the hydrographic office is evidently of great value and importance to our commercial and business interests, and must save many vessels from wreck, and many lives from destruction. Naval vessels under direction and instruction of the hydrographic office also survey foreign coasts and unsurveyed harbors and channels, aiding powerfully in the extension and introduction of our commerce to such coasts and harbors; and they contribute to the knowledge of the earth and its inhabitants by deep-sea soundings, by observations of the currents and winds and storms, and of the bottom of the ocean and of its shores.

While this work is scientific work, your committee is not prepared to recommend that it be detached in any way from the control of the navy department; nor can they recommend that the hydrographic work of the coast-survey, for over forty years conducted so satisfactorily under the civil control of the coast-survey, be separated from that organization before the original survey shall be completed. After that is done, perhaps the work of re-sounding and of re-examining may, without injury to the service, be committed to the control of the navy department. Yet even then correction and revision of the coast-survey charts will require some co-ordination, some authoritative connection between the coast-survey office and the parties and vessels engaged in these re-examinations for correction of our coast charts.

From the terms of the act under which your committee is considering this subject, it may be inferred that the principal question affecting the hydrographic office, on which an opinion is desired, is that of its consolidation with the hydrographic work of the coast-survey. The reasons for the consolidation of these two works under the navy department have been urged with force by the secretary of the navy in his last two annual reports. But there are also cogent reasons on the other side of this question. The coast-survey was specially organized to secure the harmonious co-operation of civilians, officers of the navy, and officers of the army, each in his own department, and yet in a single well co-ordinated work. No scientific department of the government has worked more successfully through the forty years in which this organization has been in operation. Each of the three branches thus harmoniously co-operating has received the benefit of the skill and professional experience of the other.

An organization of this sort should not, while its work is going on, be disrupted, except for very strong reasons affecting its efficiency. We would also advert, in illustration of the advantages which our military and naval officers have derived from their connection with the coast-survey, to the brilliant list of military and naval men during the civil war, who derived a very important part of their professional training from their experience on that work. Such a list would include an array of professional leaders which it would be difficult to collect from any other associated body of men. We suggest the names of Porter, the Rodgerses, of Meade, and of Humphreys. Many others might be added, who, after service on the coast-survey, rose to high employments in the army and navy.

While, therefore, your committee is not prepared at the present time to recommend the proposed consolidation, it does not conceive that congress should adopt measures looking to the separation in perpetuity of the two branches under consideration. The policy of the coast-survey should, we conceive, be directed towards the completion at the earliest possible date of the survey of our coast-line. Its main operations will thereafter be confined principally to the interior, and then the policy of consolidating its hydrography with the work of the naval hydrographic office will be open for consideration. We are therefore of opinion that the hydrographic office of the navy department is worked with all due efficiency as it is now organized, and that no change is at present necessary in its relations to the government.

Preliminary to our recommendations as to the other three works upon which your committee is called upon to report, it desires to present some general views respecting the working of the departments of the government. We conceive it desirable that there should be a clear understanding as to what sorts of scientific investigation may be undertaken by government organizations. We conceive it to be a sound principle that congress should not undertake any work which can be equally well done by the enterprise of individual investigators. Our leading universities are constantly increasing the means of scientific research by their professors and students; and, while the government may with propriety encourage and co-operate with them, there is no reason

why it should compete with them. The scientific work of the government ought not, therefore, to be such as can be undertaken by individuals. It should also be confined to the increase and systematization of knowledge tending 'to promote the general welfare' of the country. Within these two restrictions there is a large and increasing field, which is only partly occupied by the organizations now under consideration. In considering the limits of its functions, your committee, as one of scientists and not of constitutional lawyers, naturally confines itself to considerations affecting the general welfare.

The general government having commenced a general trigonometrical survey of the United States on a large scale, under organizations much more efficient in their action than those which any single state can provide, we conceive it desirable that the work thus undertaken should be continued at least to the point at which it can be advantageously taken up by the states themselves. At what precise limit the general government should stop, we are not prepared to decide, nor is it necessary that this limit should be defined at present. The attention of congress should also be directed to the fact that the administration of a scientific bureau or department involves greater difficulties than that of a purely business department. The connections between the work done and the results ultimately to be attained for the public are not at all obvious to the people and press, and thus the great benefit of vigilant watching and constant criticism is wanting. Again: its administration requires a combination of scientific knowledge with administrative ability, which is more difficult to command than either of these qualities separately. These difficulties are intensified by the absence of any central authority to control the work of a government scientific organization. Each head of a scientific organization is now practically absolutely independent, and, in his individual judgment of what his organization shall do, is controlled only by congress itself, acting only through its annual appropriation bills. We conceive that this state of things calls for measures of reform.

A feature of such reform will be the collection of the organizations now under consideration, together with such other scientific bureaus as congress may see fit to include in the scheme, under one central authority, to be recognized as responsible for, and controlling generally, the scientific operations of the government. Various forms of such an authority might be devised, the choice of which will some day be made by congress. The best form would be, perhaps, the establishment of a 'department of science,' the head of which should be an administrator familiar with scientific affairs, but not necessarily an investigator in any special branch.

Your committee states only the general sentiment and wish of men of science, when it says that its members believe the time is near when the country will demand the institution of a branch of the executive government devoted especially to the direction and control of all the purely scientific work of the government. In this day the pursuit of science itself is, visibly to all men of education, directly connected with the promotion of the general welfare. The art of photography, beginning in 1802 with the scientific experiments of Wedgewood, has developed, till, in this country alone, the annual value of photographs produced is estimated at thirty millions of dollars. The study of electricity has resulted in the telegraph, the telephone, the electric light, the electric railway; some of which results count their revenue by millions, and have created already, within a few years of their discovery, properties employing the capital of hundreds of millions. None who have lived with open eyes during the development of these results of purely scientific investigation doubt that the cultivation of science 'promotes the general welfare.'

Should such a department be now impracticable, should public opinion not be now ready for it, the next best measure, in the opinion of scientific men, would be to transfer all such work or bureaus to some one executive department. Keeping in mind what has been said respecting the two classes of work under the signal-service, we are of opinion that the functions of the several organizations under consideration could now be most advantageously divided among perhaps four bureaus; namely, —

1°. The coast and interior survey, to be concerned principally with geodesy and hydrography, and to consist of the present coast and geodetic survey.

2°. The geological survey, to comprise the present geological survey with its organization unchanged.

3°. The meteorological bureau, to which should be transferred so much of the present *personnel* and functions of the chief signal-office as are not necessary to the military duties of that office.

4°. A physical observatory, to investigate the laws of solar and terrestrial radiation, and their application to meteorology, with such other investigations in exact science as the government might assign to it. In this connection, attention is called to a resolution passed by the recent electrical conference in Philadelphia, requesting the establishment, by the government, of a bureau of electrical standards. We are of opinion that the functions of the bureau of weights and measures, now performed by the coast-survey, could be advantageously transferred to the proposed bureau, and extended so as to include electrical measures.

The members of your committee are conscious that placing these bureaus under one department would not necessarily result in the proper co-ordination of their work, because the head of such department would probably find it impracticable to enter into the consideration of all details necessary to that purpose. It appears to us that the evils already pointed out require, in any case, the organization of a permanent commission to prescribe a general policy for each of these bureaus. The functions of this commission would be: —

1°. To examine, improve, and approve the plans of work proposed by the several bureaus, and to revise their estimates in accordance with such plan. The performance of this duty would require consultation with their chiefs generally and separately respecting

the character of their work, and they should be members of the commission.

2°. To approve in detail the methods of expenditure of the appropriations.

3°. To recommend such measures as they deem necessary to the efficiency of the bureaus under their supervision. It should, however, be understood that this commission is not charged with purely administrative responsibility. It prescribes what shall be done, and recommends any measures necessary to secure that object, but does not concern itself with administrative details.

We submit the following as a suggestion for the formation and *personnel* of such a commission: —

The commission shall consist of, 1°, the president of the National academy of sciences; 2°, the secretary of the Smithsonian institution; 3° and 4°, two civilians of high scientific reputation, not otherwise in the government service, to be appointed by the president of the United States for the term of six years; 5°, one officer of the corps of engineers of the army; 6°, one professor of mathematics in the navy, skilled in astronomy, — these two to be designated by the president of the United States for a term of six years, — who, with, 7°, the superintendent of the coast and geodetic survey; 8°, the director of the geological survey; and, 9°, the officer in charge of the meteorological service, — shall constitute the commission of ———. The secretary of the ——— department shall be *ex-officio* president of the commission.

The members of the commission, for their services as such, shall each be paid by the United States compensation in the sum of ——— dollars per annum. Their necessary transportation and travelling expenses shall be provided for as are those of officers of the army and navy when travelling on public business or duty, to be paid out of the appropriations for the services under their supervision.

The commission shall meet in Washington, D.C., for the transaction of business, not less than four times a year; but the president of the commission may convene it whenever in his judgment the exigencies of the service require a meeting.

The commission shall be attached to the office of the secretary of the department of ———, and under his superintendence shall exercise a general control over the plans of work of the coast and geodetic survey, the geological survey, and the meteorological service, and shall have the charge and custody of all the archives, books, documents, drawings, models, returns, apparatus, instruments, and all other things appertaining to the commission.

The estimates of the heads of these bureaus or offices shall pass through the commission for revision and approval; and, after the annual appropriations have been made, no money shall be expended under them, except after revision and approval by the commission of projects submitted by these bureaus in compliance with such projects.

If at any time public money is being spent by any of these bureaus, not in accordance with the views of the commission, the commission shall notify the proper auditor of the fact.

THE ADMINISTRATION OF THE SCIENTIFIC WORK OF THE GENERAL GOVERNMENT.[1]

IN response to your oral request at the session of yesterday to present to the commission my "opinions relating to the organization of the scientific work of the government on a comprehensive plan, by which the work can be more thoroughly co-ordinated, more systematically prosecuted, and more economically administered, than at present," I beg leave to make the following statement: —

The scientific works prosecuted under the general government of the United States, and in like manner prosecuted by other nations, may broadly, but with sufficient accuracy, be classed under two heads. In the first class are constructive works, such as the erection of public buildings, the improvement of rivers and harbors, and the construction of light-houses. In all of the operations of this class, in order that the work may be properly executed, scientific principles and methods must be observed; but such works chiefly involve problems of applied science. The second class of operations in which the government of the United States, like all other civilized nations, is engaged, involve in their nature original investigation. They are designed, in large part, to furnish needed information to the people; and they not only involve questions of applied science, but, that the purpose for which they are prosecuted may be properly accomplished, new facts and principles must be discovered. Such institutions are the geological survey, the coast and geodetic survey, the signal-service or meteorological bureau, the fish-commission, the national museum, the hydrographic bureau, and the national observatory. The functions of such bureaus cannot properly be performed without scientific research, and their value depends upon the wisdom and efficiency of the methods of investigation pursued. It is to this second class, of purely scientific institutions, designed for and necessarily comprehending original research for the purpose of giving information to the people, that I confine my remarks.

The operations of such institutions are exceedingly complex, and, from their very nature, cannot be antecedently planned and executed according to such original plan. At every step of the work, plans must necessarily be modified, as necessitated or suggested by discovered facts. It is therefore impossible by law to organize such operations; and, more, it is impossible for the directors or superintendents of such work to lay out plans of operations which shall be a full guide to their assistants. A clear conception of the object to be attained, and a comprehensive knowledge of the principles to be used in the guidance of research, are necessary; and beyond that, from time to time, as facts are discovered, and the avenues of investigation are opened, the work is directed in its details. It will thus be seen that it is

[1] From the testimony of Major J. W. POWELL, director of the U. S. geological survey, before a joint committee of both houses of congress.

impossible to directly restrict or control these scientific operations by law. The general purpose of the work may be formulated in the statutes, and the operations may be limited by the appropriations made therefor, and this is as far as the statute itself can properly go; for, if the operations themselves could be formulated in law, the facts would already be known, and the investigation would be unnecessary. It being impossible by statute to control or restrict the lines of investigation, as above shown, there is yet a control of the official personal organization which can properly be exercised by statutory provision; and a further control, superior to the immediate organization prosecuting the work, may be properly exercised in relation to the financial operations in the payment of employees, and in the purchase, use, and custody of public property, and the supervision of accounts.

I beg permission to set forth certain facts, which, I think, should be used as a guide in the establishment of such official organization and superior control. In the first place, the investigations prosecuted by all of these scientific institutions are in their nature inter-related and interdependent. The success of one is dependent, to a large extent, upon the success of the others; and, if at any time in the correlated investigations prosecuted by the general government any one branch fails in its department, the other branches suffer therefrom to a greater or less extent.

For example: geodetic operations carried on throughout the world, and having for their purpose the determination of the figure of the earth, were for a long time prosecuted by refined trigonometric methods; but, as the work progressed, the problem was found to be more complex than was at first supposed, and elaborate gravity determinations were added to trigonometric methods. And it has quite lately been discovered that trigonometric and gravity methods must yet be supplemented by the determination of the geologic structure of lands, especially of mountains and mountain systems. Thus it has been found that the geographer cannot accomplish his work without appealing to the geologist for his knowledge. On the other hand, it has been found in the study of structural geology — and by that is meant the plan upon which the rocks composing the lands of a country are arranged — that it cannot be clearly understood and explained without the facts of geodesy. Sound geologic research, therefore, must progress hand in hand with sound geodetic research.

Again: in the prosecution of geodetic research, the parties thus engaged determine the exact position in latitude, longitude, and altitude, of many points upon the surface of the earth. In the prosecution of a geologic survey of the same territory, these same points must also be known; but, more than that, their number must be vastly multiplied, so that a map may be constructed setting forth the latitude, longitude, and altitude of all portions of the country surveyed. Where the geodetic survey establishes but hundreds of points, the geologic survey must have millions of points established.

Again: the points to be used in the geodetic survey must necessarily be selected for that purpose. A general reconnoissance of the country over which such a survey is carried must be made, and the materials collected for at least a skeleton map. Thus it is that a skeleton map is necessary for a geodetic survey, and a completed map for the geologic survey. In like manner it can be shown that the relations between geodetic and geologic work are manifold, and, still further, that the geodetic work and the geologic work have a great variety of connections with the other scientific works prosecuted by the general government. It would require a volume to set forth all these relations, and to show how completely the success of one is dependent upon the success of all.

It will thus be seen that the official organizations for these institutions should be co-ordinated, that they may work together and aid each other; and, further, as each is interested to a greater or less extent in the operations of the other, the organization should be such that one shall not be compelled to do that which is the proper function of another, and that no one shall be permitted to encroach upon the functions of another. As long as the several scientific commissions and bureaus of the general government are distributed through all the departments of the government, — one in the war department, another in the navy, another in the interior, another in the treasury, etc., — each bureau must necessarily, to a large extent, be autonomous: they must be self-governed, for it is a practical impossibility for any secretary of a general department to make such a study of the methods of scientific research as would warrant him in attempting their control. Hence these institutions have in the past been to a great degree autonomous, and must, under the same plan, continue to be.

If the statements thus briefly made are correct, it follows that the first guiding principle to the proper official organization of the scientific work is as follows: *The scientific institutions of the government should be placed under one general management.*

Again: as a necessity, scientific investigation must be controlled by the facts discovered from year to year, and from month to month, and from day to day. The operations of investigation, therefore, can only be controlled by the men who are actually performing the work. For example: the director of the geological survey cannot possibly lay out the work for his assistants in detail. He can only set forth in a general way the object to be reached, the general methods to be pursued; and such plans must be held open to revision from time to time as the facts discovered by the investigators themselves may demand. He must therefore hold himself always in communication with his assistants, and ever be ready to entertain their suggestions; and there is always a probability that he will err more in the direction of rejecting wise suggestions than accepting unwise plans.

It is thus that, to a large extent, the plans of the work prosecuted by an organization for scientific research must originate with the experts and specialists who are themselves engaged in the investigation; and

the most important function which the director of such an institution has to perform, lies in the selection of the proper men, — the specialists who have a genius for research. From the very nature of the work performed, the plan of operations to a large extent must come up from the individuals who are doing the work, and can only to a limited extent originate with the director. Out of the multitude of plans and ideas thus suggested by a corps of specialists engaged in original research, the superintendent or director selects such as he thinks wise, and is successful in his work to the degree in which he has a comprehensive knowledge of the subject.

If the above considerations are correct, the second guiding principle for controlling scientific work of the government is as follows: *The several bureaus engaged in research should be left free to prosecute such research in all its details, without dictation from superior authority in respect to the methods of research to be used.*

I beg to call the attention of the commission to certain statements of the committee of the National academy of sciences, which constitute a part of the record of the proceedings of this commission. These statements are as follows: —

Your committee states only the general sentiment and wish of men of science when it says that its members believe the time is near when the country will demand the institution of a branch of the executive government devoted especially to the direction and control of all the purely scientific work of the government. In this day the pursuit of science itself is, visibly to all men of education, directly connected with the promotion of the general welfare. . . . The members of your committee are conscious that placing these bureaus under one department would not necessarily result in the proper co-ordination of their work, because the head of such department would probably find it impracticable to enter into the consideration of all details necessary to that purpose. It appears to us that the evils already pointed out require, in any case, the organization of a permanent commission to prescribe a general policy for each of these bureaus. The functions of this commission would be, —

1°. To examine, improve, and approve the plans of work proposed by the several bureaus, and to revise their estimates in accordance with such plan. The performance of this duty would require consultation with their chiefs, generally and separately, respecting the character of their work; and they should be members of the commission.

2°. To approve in detail the methods of expenditure of the appropriations.

3°. To recommend such measures as they deem necessary to the efficiency of the bureaus under their supervision. It should, however, be understood that this commission is not charged with purely administrative responsibility.

It prescribes what shall be done, and recommends any measures necessary to secure that object, but does not concern itself with administrative details.

It will be seen from this extract that the learned members of the national academy constituting that committee, fully recognize the importance of a unified administration of the scientific bureaus. The same committee further expresses the opinion that a department of science is desirable; but, fearing that such a department cannot be organized at the present time, a commission is recommended, to be composed of a secretary of one of the departments of the government, the president of the National academy of sciences, the directors or superintendents of the scientific bureaus, a professor of mathematics from the naval observatory, an officer of the engineer corps, and two citizens of the United States, eminent as scientific men, to be appointed by the president.

Sympathizing fully with the general tenor of the recommendations of the academy, I wish to present certain reasons for objecting to the constitution of the board of commissioners as recommended by that committee. The objection to such a board is twofold. In the first place, it would be composed of incongruous elements. A board composed of civil and military officers would, it is believed, be inharmonious, from the fact that military and civil methods of administration are entirely diverse, and proceed upon diametrically opposed theories. The military officer plans and commands: the civil officer hears, weighs, and decides.

In the second place, the board, as thus recommended, would be impracticable in its relations to the departments under which the several scientific bureaus are placed. Officers subordinate to the secretary of war, and officers subordinate to other secretaries, together with officers having no other connection with the government but as members of this board, would have the practical control of the work, so far as it could properly be controlled; and the secretaries themselves would simply be channels through which instructions to the bureau officers would be transmitted.

This, it is feared, would be irksome to executive officers composing the cabinet of the president. It is a matter of record in the proceedings of this commission, that Professor Newcomb of the navy department, and Gen. Comstock of the army, withdrew from the committee of the national academy at the request of their superior officers, the secretaries of those departments. It is presumable that this action was taken because the military secretaries did not desire to have their subordinates deliberate upon questions of policy affecting the conduct of the secretaries themselves; and this was entirely natural and proper, from a military stand-point, where superior officers plan and command, and inferior officers obey and execute. In a civil department of the government it would have been entirely in the course of things, and in no respect a violation of official proprieties, for subordinate officers to present plans, even of general policy, to their superiors.

Having thus briefly commented upon the plan of the academy committee, I beg permission to suggest a plan which would not involve the same difficulties. There is, in the organization of the general government, an existing body of officers competent to coordinate the scientific work, with an organization peculiarly fitted to supervise the general plans, and yet leave the officers of the several scientific bureaus free to carry on the details of operations by scientific methods, as they are developed from time to time. I

refer to the regents of the Smithsonian institution. These regents are composed of the chief justice, the vice-president, three members of the senate, and three members of the house of representatives, and six citizens. These regents are appointed as follows:—

The regents to be selected shall be appointed as follows: the members of the senate, by the president thereof; the members of the house, by the speaker thereof; and the six other persons, by joint resolution of the senate and house of representatives.

This body of regents appoints a secretary of the Smithsonian institution, who is its executive officer. If such of the scientific bureaus as should properly have a civil organization were placed under the direction of the regents of the Smithsonian institution, perhaps the best possible administration of the scientific work of the government would thereby be secured; and the learning and administrative ability of the present secretary of that institution would furnish abundant assurance that the organization of these departments under a common head, would, at its inception, be thorough and wise.

The history of the Smithsonian institution, with its governing board constituted as above, is the best warrant that could be given for a wise administration of the scientific operations of the general government. The first secretary of that institution, Professor Henry, was one of the great scholars of his time; and, under his administration, the affairs of the institution were conducted so as to meet with the approbation alike of the congress of the United States, the learned men of the country, and the people at large. His successor, Professor Baird, one of the leading scholars of the world, has conducted the operations of the institution as assistant secretary, and subsequently as secretary, in such a manner that the government of the United States has intrusted to him much larger and wider duties in the administration of the fish-commission and the national museum. It will thus be seen that the board of regents would constitute an able and efficient supervisory body; and it may always be expected that the executive officer of that board would be a man thoroughly competent to execute such a trust.

I next come to the consideration of the subject as to what bureaus should be placed under this common organization. Two of the bureaus already mentioned are now under the Smithsonian institution; namely, the fish-commission and the national museum. The geological survey could be very properly added to the number. Its relations to the national museum are very intimate. All of its collections of rocks, ores, minerals, and fossils, are deposited therein; and its laboratories for the study of these collections, chemical, physical, and paleontological, are also in the national museum, as they must necessarily be connected with the collections. This relation between the geological survey and the national museum is not by virtue of organic law, but solely by convention between the secretary of the Smithsonian institution, and the director of the geological survey, and is a special courtesy to the geological survey, extended by the secretary of the Smithsonian institution. In like manner the geological survey has intimate relations with the fish-commission. In that commission it is necessary to employ a corps of biologists. The paleontologists of the geological survey also constitute a corps of biologists. The biologists of the fish-commission study the living forms in the existing bodies of water on and around this continent; the biologists of the geological survey study the fossil forms of the same region, some of which still exist, others of which have become extinct; and the biologic work of the two departments is so intimate, that at times the biologists of the fish-commission perform work for the geologists of the survey, and at other times the biologists of the survey perform work for the fish-commission and the national museum. It is very clear, therefore, that the geological survey could appropriately be placed under the same management as the fish-commission and the national museum.

The coast and geodetic survey must first be considered in its relations to certain other departments of scientific work. The committee of the academy recommend the establishment of "a physical observatory to investigate the laws of solar and terrestrial radiation, and their application to meteorology, with such other investigations in exact science as the government might assign to it." And they also recommend that the functions of the bureau of weights and measures, now performed by the coast-survey, be extended so as to include electrical measures, and that the whole be transferred to the new bureau recommended. The coast and geodetic survey already has under its charge the bureau of weights and measures. It is also engaged in magnetic researches, and could appropriately undertake electrical researches, and also the researches relating to solar and terrestrial radiation. I do not think that it would be best to create a new organization for the purposes thus indicated, but that it would be the part of wisdom to enlarge the functions of the present organization of the coast and geodetic survey to accomplish the desired purpose.

I have already mentioned that the national observatory is one of the institutions engaged in original research of such a character that it should form one of the co-ordinated bureaus, but it would not be necessary to transfer it as an independent bureau. It might properly be consolidated with the coast and geodetic survey. Under such a plan, this survey would have for its functions geodetic investigations, the methods of which are in part astronomical. It would also have the gravity investigations, and the investigations relating to solar and terrestrial radiation, which are also in part astronomical. It would also have the magnetic and electrical investigations. All of these lines of research are intimately related and profoundly interdependent.

I come now to a consideration of the survey of the immediate coast of the United States. The primary purpose of this survey is the construction of charts to be used by mariners. This survey of the coast

proper is nearly completed, and should be finished by the present organization. When thus finished, the work of the coast-survey on land will be practically ended, but the hydrographic operations must be permanently continued. In this hydrographic work a large corps of naval officers and seamen are employed under the coast-survey; and the navy is also engaged, under the organization of the hydrographic bureau, in conducting researches of like and related character off the coast. It is evident that this hydrographic work prosecuted by the coast and geodetic survey is pre-eminently a naval work, from the fact that officers and seamen of the navy are employed in its prosecution. The officers of the navy are necessarily, and should be, the geographers of the sea. Statesmen agree, that, even in time of peace, a naval establishment must be maintained. A school is supported by the general government for the education and training of officers to command its navies. This training should be continued by practical operations at sea, not by engaging in unnecessary war, but in the navigation of the seas and the management of vessels; and, while thus engaged, the navy may be appropriately and economically employed in the study of oceanic geography. I am therefore clearly of the opinion that the hydrographic work of the coast and geodetic survey should be transferred to the hydrographic bureau of the navy. As thus organized, it would necessarily have a military administration, and could not properly be placed with the other scientific bureaus enumerated above under one common management. There would yet necessarily be relations existing between the bureau of navigation and the other scientific bureaus; but they would be of a much less fundamental character, and would be limited in scope, and the few relations thus existing could be properly adjusted by convention.

If the signal-service is to have a military organization, it would be unwise to directly associate it with bureaus with civil organizations, for reasons already stated. Should it be deemed wise to include it in the group of scientific institutions, it should then be reorganized on a civil basis.

The various lines of research enumerated in characterizing the scientific bureaus above are such as properly pertain to the functions of government in the common judgment of mankind. The warrant for this statement exists in the fact that the leading civilized governments of the world do, in fact, provide for the prosecution of such operations. The subject of the endowment of such research by government has been widely discussed by statesmen and by scholars in America and in Europe alike; and the wisdom of such endowment, and the fundamental principles that should control such work, have been again and again clearly enunciated. The actual practice of the several governments engaged in this work is to a large extent harmonious, but in some important particulars there is diversity of methods. In the British government a part of the scientific research is controlled by organizations in the executive departments: another part is controlled by scientific societies organized under royal charters, and receiving grants of money from the general government. In the German states various methods are adopted, one of the most important of which is that the universities receive grants from the general government for scientific research. This latter method largely prevails in Russia; but in all of these countries the methods adopted in the United States are steadily gaining ground, and the practice of European governments is steadily following the precedents established in the United States.

The questions submitted by act of congress to the deliberation of this commission affect profoundly all of the important industries of the land. You are to decide for the people the best methods of utilizing the results of all scientific research, as they pertain to the welfare of the people of the United States; and your action, should it be confirmed by congress, will ultimately affect the deepest interests of all the people; and the influence of your action will be exercised in promoting or retarding scientific research itself, which is the chief agency of civilization, and the results of which constitute the chief elements of civilization.

THE AMERICAN SOCIETY FOR PSYCHICAL RESEARCH.

AT a meeting held in Boston, Jan. 8, the organization of the society was completed. The conduct of the affairs of the society is by the constitution placed in the hands of a council of twenty-one, which consists of Prof. G. Stanley Hall of Baltimore; Mr. George S. Fullerton of Philadelphia; Dr. William James, Prof. E. C. Pickering, Prof. J. M. Peirce, of Cambridge; Mr. Coleman Sellars of Philadelphia; Major A. A. Woodhull of New York; Professor Simon Newcomb of Washington; Drs. C. S. Minot and H. P. Bowditch, and Messrs. W. H. Pickering and C. C. Jackson, of Boston; Col. T. W. Higginson and Mr. N. D. C. Hodges, of Cambridge; Prof. George F. Barker of Philadelphia; Mr. S. H. Scudder and Prof. C. C. Everett, of Cambridge; Mr. Morefield Storey of Boston; Professor John Trowbridge of Cambridge; Mr. William Watson of Boston; and Professor Alpheus Hyatt of Cambridge. Professor Newcomb has been chosen by the council as president of the society, and Profs. Hal, Fullerton, E. C. Pickering and Drs. Bowditch and Minot, as vice-presidents; Mr. Watson, treasurer; and Mr. N. D. C. Hodges, secretary.

After the organization was completed, Professor Pickering, who was in the chair, referred briefly to the work of the committee on organization, which has had the matter in charge since last fall, and said that the details of organization would bear a small part in the work of the society; that there was now need of co-operation among all members in order that there might be some fruitful investigations carried on. He urged all members to look about among their friends for suitable subjects; Professor Pickering's opinion being that it would be much safer and more satisfactory to experiment on people of good standing, who might exhibit powers of mind-reading, or

might be good subjects for hypnotic experiments, rather than employ the professionals, many of whom are doubtless tricksters. He referred to the wide interest which is exhibited now throughout the whole world in the prosecution of psychical research.

The committee on work, or suggestions as to possible work, stated that they had sent out circulars to the members of the society, calling for volunteers as members of the investigating committees; that they had received a number of answers; that the most of them were from those specially interested in thought-transference; and they recommended the appointment of a committee on that subject. They also suggested that a circular should be issued by the society, describing the methods of making experiments in thought-transference, and pointing out the precautions to be taken. Such a committee has been appointed by the council, and will in a short time issue its circular, and commence work. It is thought best, that, in order to confine as far as possible the possibility of guessing correctly what is in a person's mind by mere chance, the object thought of should not be too simple; that is, if it is a figure, it should not be a circle, or a square, or harp-shaped. A word was suggested as a suitable thing to think of, or any one of the digits from one to ten.

There was a lengthy discussion, in which Drs. Minot and Bowditch, Professor Pickering, Col. Higginson, Dr. James, and others, took part. Many of the speakers advocated the employment of professionals, saying that it was nearly impossible, with many would-be honest mind-readers, to tell where their real power ended, and where fraud began. It was stated that some of the professionals confess that at times they eked out their powers with a mild deceit. It was felt by many that in testing professionals there would not be any feeling of restraint about using precautions against fraud; that it would be perfectly understood that all means for getting at the truth could rightfully and properly be employed.

For the present the work of the society will be confined largely to experiments on thought-transference. The committee on work hesitates to recommend to the members at large investigations in hypnotism, on account of the danger which would arise when they were carried on by inexperienced hands.

SOME RECENT EXPERIMENTS WITH OIL IN STOPPING BREAKERS.[1]

The U. S. hydrographic office, in pursuance of its policy to lessen the dangers of navigation, has recently commenced the collection of information to determine the best manner of using oil to calm the surface of troubled waters.

This matter has long been a subject of controversy. In 1844 a Dutch commission, after pouring a few gallons of oil on the storm-beaten bosom of the North Sea, and finding the waves not sensibly affected declared that the oft-repeated account of the saving of ships by this means was a fantastic creation of the imagination. Notwithstanding this, Scotch coasters have saved themselves again and again by strewing the sea with the fatty parts of fish, cut into small pieces, which were carried with them for the purpose; and so much reliable information on this subject has now been collected from the common experience of seafaring men, that the evidence in its favor can no longer be controverted.

It must be understood, however, that the use of oil does not make the surface perfectly smooth, but merely lessens the dangerous effect of what the seaman calls 'combers,' or the great broken, rolling masses of water which have first disabled and then swamped so many ships since man first began to go down to the sea.

A case lately reported of the use of oil is that of the steamship Thomas Melville, while running before a gale in February, 1884, when she was constantly boarded by heavy seas. As her situation became more and more critical, it was determined to try what effect oil would have upon the water. Two canvas bags holding about a gallon were made, therefore, punctured in many places with a sail-needle, and filled with oil. These bags were hung over the bows, and allowed to drag in the water. The seas no longer came on board, and the safety of the vessel was secured. The bags were refilled every four hours.

The application of oil to the quieting of water at the entrances of harbors is one that has received very considerable attention; and credit is due to Messrs. Shields and Gordon of England for their energy and enterprise, as well as for the thought, time, and money expended in endeavoring to establish its use, and in bringing the subject into prominent notice.

At Folkestone, Eng., Mr. Shields's apparatus consisted of three large casks placed on shore at the end of the old mole. These were connected by pipes with small hand-pumps, each of which was worked by one man. Two lead pipes about an inch and a quarter in diameter extended from the casks along the bottom, through the entrance to the harbor, about 2,950 feet toward's Shakespeare's Cliff. At intervals of every hundred feet, vertical pipes were soldered to the main pipes; and in the former were placed conical valves properly protected from mud and slime by caps.

Unfortunately, on the day set apart for a public exhibition the weather was not entirely favorable; that is to say, the wind was not from the right direction. The sea, however, was sufficiently disturbed to show the working of the apparatus. When the oil was pumped through the tubes, it soon showed its effect upon the surface; and this became more apparent as the amount of oil was increased.

A broad glassy strip was soon distinguished which was more than a half-mile long. A fully manned lifeboat, which was sent into the oil-covered strips of water, was tossed about in a lively manner, but took in no spray. Meanwhile the sea outside of the strip was everywhere breaking into white caps. After

[1] Communicated by Capt. J. R. Bartlett, chief hydrographer of the navy.

stopping the pumps, it was found that the amount of oil used was a little over a hundred and nineteen gallons.

Three hours after the close of the trial, the Boulogne steamer passed broad strips of comparatively smooth water, on which the oil still lay.

After this experiment, two of Mr. Gordon's inventions were tried. One of these consists of a shell fired from a mortar, and so arranged that it bursts on striking the water, and frees its contents of oil. The shell is specially constructed, and has an ingenious device for insuring its explosion, which is effected by a fuze and gunpowder. This recommends itself as a practical means to render less dangerous the communication between ships by boats during heavy weather. In case of shipwreck, also, the approach of lifeboats could be greatly facilitated.

The second invention is an arrangement to make a lane of oil from the shore to a stranded ship. To effect this, an iron cylinder is fired from a mortar in the direction of the ship. The cylinder, which serves as an anchor, draws after it a leather hose fastened to it by a line. Oil is then pumped through the hose, and, being spread towards the shore by the wind, forms a quiet surface for the rescuing boat.

Various ingenious contrivances have been invented for applying the oil to the water; but the simplest and readiest, at the same time most effective, appliance is a canvas bag, either rather loosely sewed together, or pierced with small holes to allow the oil to escape. This has been the method adopted in the most successful cases reported from ships at sea, and has been found effectual in some of the lifeboats. It has the great advantage of being self-acting, insuring a regular stream of oil, and being easily renewed when exhausted.

In a vessel or boat running before a sea, one should be hung over each bow, which gives the oil time to spread before reaching far astern. In a ship, when hove to, one or more bags have sometimes been hung over the weather side, and sometimes been put overboard to windward, attached to light lines. This is the best plan, because, not drifting so fast as the ship, the bag will be carried to windward, and fulfil the condition of applying the oil to the water at some distance from the ship, in the direction from which the waves are advancing.

An open boat, unable to run before the sea, will always endeavor to put out some form of sea-anchor, with a rope attached to it: the bag of oil should be attached to this, and, failing every thing else, a boat's mast or a sail loosed is very effective.

When the boat is anchored, the bag could be attached by a light line to the anchor as a buoy. This appliance, in addition to being efficient, has the great merits of handiness and simplicity. Two such bags, holding about a gallon of oil each, with the line attached, might be kept full, and packed in a small cylinder similar to a paint-pot or a preserved-meat tin, and would form neither an expensive nor cumbersome article of equipment in a boat.

In the absence of these or similar contrivances, the oil could be poured from a bottle or can; but this would require a man's attention when one could be ill spared possibly, and might not insure so constant or regular a supply, which is of importance. This would not be applicable to a boat at anchor.

REPORT OF THE SUPERINTENDENT OF THE U. S. NAVAL OBSERVATORY.

THE report of Commodore S. R. Franklin, who succeeded Admiral Shufeldt as superintendent of the observatory on Feb. 21, gives, under date of Oct. 29, 1884, a summary of the work accomplished during the year. In organization a slight change has taken place by the appointment (by the superintendent) of a board consisting of the superintendent, the senior professor of mathematics, and the senior line-officer, to determine the scope and character of the work to be done. The board may be convened at the request of any member, and a weekly report is submitted to the superintendent every Monday by each officer in charge of an instrument.

The twenty-six inch equatorial, in charge of Professor Hall, has been employed mainly in observations of the satellites of Neptune, Uranus, Saturn, and Mars, and of double stars, with a few observations for stellar parallax. In the case of Uranus, the observations were confined mostly to the outer satellites; and it is proposed now to discontinue them, since the favorable time for determining the position of the orbit planes of these satellites has passed. The reductions are all well advanced.

The transit circle has been under the charge of Prof. J. R. Eastman, and has been employed in observations of the sun, moon, planets, comets, and a catalogue of miscellaneous stars, as in previous years. The nine-inch equatorial, in charge of Commander Sampson, has been used in observing comets, minor planets, and occultations. The series of observations with the prime vertical instrument was practically finished in May, 1884. The reductions are being carried on by Ensign Taylor. The meridian transit instrument has been used primarily to determine clock corrections, in connection with the daily time-service. Observations for the right ascensions of the sun, moon, and major planets, have also been made.

The time-service has been considerably extended. In addition to the lines already existing, the Baltimore and Ohio telegraph company looped two of its main circuits into the observatory, and the signal-service looped one. In March last a proposition was submitted to the heads of the several departments in Washington, to place in the more important offices of the government, including the executive mansion and the capitol, a clock that should be regulated and controlled every day from the observatory, which establishment should be responsible for the determination and transmission of correct time. This plan met with general approval; and an insulated circuit was established connecting the various offices, some twenty in number, with the observatory. In each

of these offices is a clock which is corrected daily, at noon of standard time, by means of an automatic attachment (the invention of Mr. W. F. Gardner, the instrument-maker of the observatory), actuated by the current which makes the signal for dropping the time-ball at the observatory, and on the Western union telegraph company's building in New York.

In the publication of its annual volumes, the observatory has been much embarrassed, owing to the limited amount of the printing-fund of the department. The volume for 1880, which it was expected would be ready by the 1st of January, was not received until October; and the computations, even with the small working force available, have been carried much beyond the printing.

In regard to the proposed new observatory, the superintendent says, —

"I cannot too earnestly urge upon the bureau the necessity of commencing the buildings for the new observatory. The ground having been purchased, and the plans made and approved, there seems to be no good reason why the construction should not begin. The present site is notoriously unhealthy, and the buildings are dilapidated and much in want of repair; and it would not be in the interest of economy to make any extensive repairs while the erection of new buildings is in contemplation. The delay is very prejudicial to this establishment in particular, and to the cause of science in general. I respectfully request, that, if all the money cannot be appropriated for the purpose aforesaid at the coming session of congress, a portion of it, at least, may be asked for, in order that this work, now so long delayed, may be begun."

An estimate of $586,138 is submitted for erecting the necessary buildings.

An appendix contains a report by Professor William Harkness, showing the progress made in the reduction of the transit of Venus observations. The photographic negatives (over fifteen hundred) have all been measured, and very considerable progress has been made in the computations necessary for the reduction of these measurements. An extended investigation is now being made of the focal lengths of the photographic objectives, and the radii of curvature of the heliostat mirrors.

BANDELIER'S ARCHEOLOGICAL TOUR IN MEXICO.

The author of the report before us is well known in New-England archeological circles, having won for himself a fair name through the publication of three essays, — on the art of war and mode of warfare, the distribution and tenure of land, and the social organization and mode of government, in ancient Mexico. In consequence of these scholarly discussions, the archeological institute, in 1880, commissioned Mr. Bandelier to investigate the condition of the sedentary Indians of New Mexico, and in 1881 a second time commissioned him to carry out an archeologic exploring-tour through Mexico proper. The report under consideration, profusely illustrated, and numbering three hundred and twenty-six pages, gives a full account of the results of Mr. Bandelier's studious researches on his second expedition.

Report on an archeological tour in Mexico, 1881. By Adolph F. Bandelier. Boston, 1884. Published in Papers of the Archaeological Institute of America. Series II.

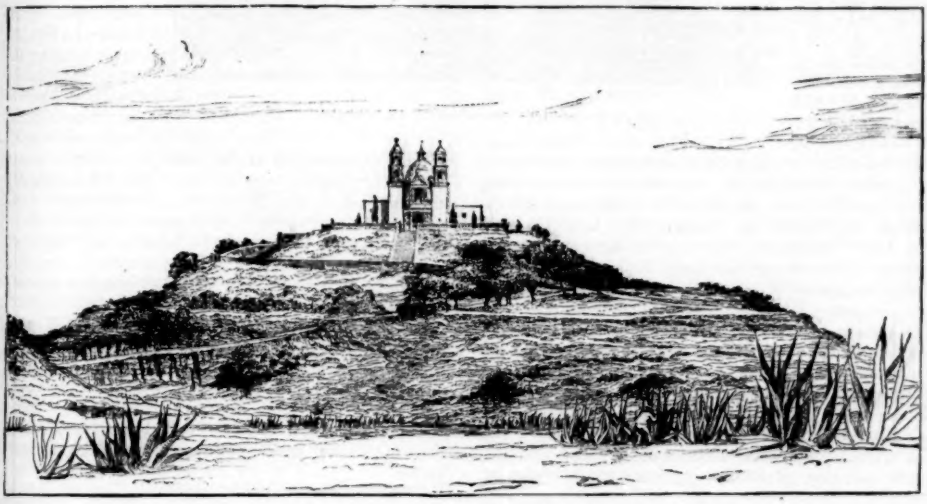
The account, it seems to us, has assumed rather the form of a scientific narrative than that of an official report made to a committee. The author was able to draw upon an immense stock of preparatory studies; and, accustomed to look at ancient Mexico through the spectacles of the chroniclers, the objects that strike his eye at each step on the classic soil remind him of some passage read, the true meaning of which he now strives to detect, with the help of ocular inspection and learned reasoning. Thus, also, the grandeur of the surrounding scenery invites him to give us data of hypsometry and meteorology, of vegetation and interesting culture-plants. He compares statistics of old with those of the present time, and cautiously avoids entering into controversy with the theories urged by other scholars or non-scholars to solve the origin of the mysterious temple and palace builders of Mexico. To be brief, by a very adroit interspersion into his text of nicely presented scientific *causeries*, Mr. Bandelier, it appears to us, may have secured for himself a larger number of readers than if he had chosen to offer a compact and matter-of-fact report.

The text is divided into four chapters. In the first chapter the author, reposing on a steamer's deck, calls us to his side, and, pointing toward the vast main, allows us to partake of the rich stock of his reminiscences. He tells us of the legends hovering around the ancient province of Huasteca, its forest-buried cities, the colossal structures of Papantla and Misantla, and deplores the fact that a thorough exploration of these hitherto but vaguely described ruins is beyond the limits of his mission. On his road from Vera Cruz to the capital, he engages in discussions on the *étapes* once taken by Mexico's first conqueror, the natural and artificial obstructions that Cortez met with, and the allies he was so fortunate as to secure in the Indians of Tlascala. After Mr. Bandelier's arrival in the capital, he very judiciously sets forth to acquaint himself with the best authorities in Mexican archeology. He takes their advice and suggestions, carefully examines the objects of antiquity preserved in the museum, and collects valuable data on the former expanse and limits of the renowned lagoons, and the modern efforts made for their regulation and draining (pp. 49–78). In the third chapter, Mr. Bandelier's independent and main work is given. It bears testimony to the most thorough exploration ever made of the often-described pyramid of Cholula, its structure, appendages, and surroundings. No hewn stone, no sculpture, no masonry or mound, remains unexamined; and no hint picked up from ancient reports, if serving his purposes of reconstruction, is slighted, but dexterously employed to give fuller shape and brighter color to the picture we are wont to form of the once stately and now decaying fabric. He succeeds, finally, in showing that in former times the giant pyramid did not stand isolated, but east and west of it were two companions, considerably smaller, however, and of the well-known teocalli-shape,

truncated, and with staircases, like the pyramid itself. As to the material of which the latter was constructed, Mr. Bandelier arrives at the conclusions of A. v. Humboldt and his successors; i.e., that it was built of large sun-dried adobes. Burnt lime for coating or for mortar, Mr. Bandelier discovers, was never employed by the Indians; pulverized limestone being prepared for the purpose. No shaft has as yet been sunk in order to ascertain whether the interior of the pyramid is of the same material as the exterior, or whether the structure was made around a natural mound, or whether it is hollow, and possibly contains some sepulchral vault of historic importance. According to tradition, the platform was crowned with a temple, in which Quetzalcohuatl, the god of air, was worshipped. The current opinions about this mysterious being are learnedly discussed.

From Cholula the traveller directs his steps southward, and visits the valleys of Oaxaca, the famous ruins of Monte Alban, Xagá, Mitla, and others. Vivid description is given of all of them, copious and careful measurements secured, and sketches as well as illustrations presented, of hitherto unobserved details.

Did Mr. Bandelier, as we presume, set forth on his exploring tour inspired by the hope of detecting in the architectural remains of Mexico proper such elements as would tend to prove these remains to represent some final stage of tectonic development, of which the initial stage must be sought in what he calls the 'tenement houses' of the sedentary Indians in New Mexico, he must have felt somewhat disappointed with the result of his investigation. We are of the positive opinion, that if in plan, as well as in execution, he had met in Mexico's architecture any traces pointing either to an intimate or only to a remote historic connection with the window-houses of the Indians of the north, he would have exulted over such discovery, and have expounded its adaptation to a certain theory that was advanced by the late Lewis H. Morgan, whom Mr. Bandelier looks up to as to a beloved teacher and friend. Not to have yielded to the temptations of a pre-occupied mind is a merit which deserves full and fair acknowledgment. It shows the faithfulness of Mr. Bandelier's observation and the conscientiousness which he brought to bear on the fulfilment of his scientific task.



THE GREAT MOUND AT CHOLULA.[1]

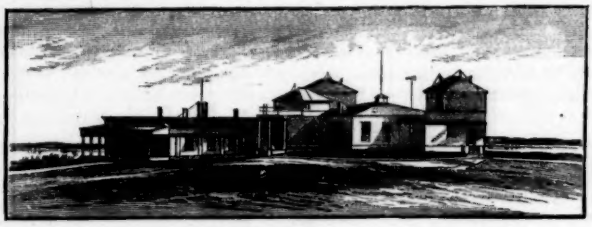
[1] Reproduced by permission of the Archæological Institute.

THE ARGENTINE ZONE CATALOGUE.

THE work for which Dr. Gould went to South America fourteen years ago, as astronomer to the Argentine Republic, is at last completed, and both the zone-lists and the star-catalogue compiled from them are published. It is not for us in a non-technical journal to discuss the purely astronomical value and accuracy of such a work, but rather, in announcing it, to recall to the contemporaries of this eminent astronomer, and bring to the attention of the younger men, — who have, even during the long progress of the work, attained an age at which they may appreciate it, — this monument of patient determination, executed under trials that might well be termed privation, exile, and affliction. During the disheartening delays in constructing the observatory and mounting the instruments, the 'Uranometria argentina,' a worthy

Zone catalogue. Mean positions for 1875.0 of the stars observed in the zones at the Argentine National observatory. By BENJAMIN APTHORP GOULD. Cordoba, 1884. 2 v. 4°.

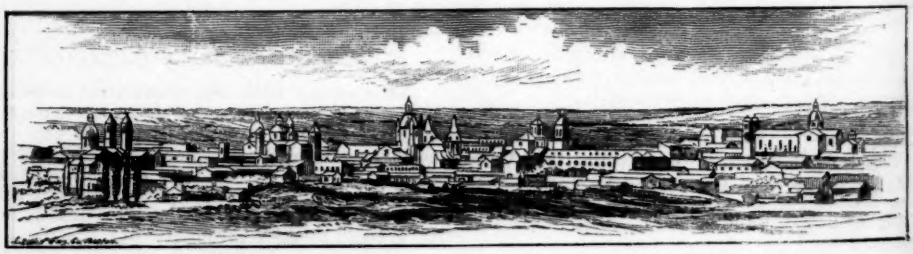
complement to Argelander's 'Uranometria nova' of the northern sky, was undertaken, and carried well toward completion, and published with star-charts in 1879, giving the estimated brightness of all southern stars, visible without telescopic aid, in about seventy grades of brilliancy. The observations for this work were made by the naked eye, or with ordinary binocular field-glasses, and entirely by the assistants; Dr. Gould's near-sightedness preventing his sharing immediately in the work, although he directed and overlooked its execution with the most minute carefulness. The zone observations, by which astronomers understand the determination of the position of stars observed in successive belts around the sky, every star being noted as it crosses the field of a meridian-circle telescope, were begun in August, 1872, and completed in 1875. In these, every one of the original telescopic observations was made by Dr. Gould; and they numbered over 105,000. Since 1875 the work of computation, revision, and publication, has occupied eight years, until now the finished catalogue is before us; and Dr. Gould may proudly feel his ambition satisfied in ending so well the work begun in outline by Lacaille with his little telescope at the Cape of Good Hope over one hundred years ago.



DR. GOULD'S OBSERVATORY AT CORDOBA.

Among the younger men who have shared in Dr. Gould's labors at Cordoba, only one has remained with him through the many years since its beginning. We feel sure from the frequent mention, in the annals of the observatory, of the faithful services of Mr. John M. Thome, that the director will gladly see the name of this assistant associated with his own in our brief notice of the work they have accomplished together.

The first of the accompanying cuts, reproduced from sketches by a former assistant, shows the observatory and the director's house on the *barranca*, from which the second view, of Cordoba in the valley of the Rio Primero, is taken. The overshadowing of the town by the churches is characteristic of the place.



VIEW OF CORDOBA FROM DR. GOULD'S OBSERVATORY.

NOTES AND NEWS.

In accordance with a recommendation of the recent geodetic conference, a series of observations for latitude is to be made at the U. S. naval observatory, which, taken in connection with a similar series made elsewhere, and compared with observations made after an interval of some years, will assist in determining whether there are any slow changes taking place in latitudes upon the earth. Lisbon, which is very near the same parallel as Washington, is expected to co-operate with the naval observatory. The observations will be made with the prime vertical instrument; and at Washington a line-officer of the navy will be detailed for the work, which will probably require several years.

—Prof. F. H. Snow of the University of Kansas reports that only two Decembers (in 1872 and 1876) in the past seventeen years were colder than that just passed. It was the cloudiest December upon record, and the precipitation of rain and snow was more than fifty per cent above the average. Ice formed upon the Kaw River to the thickness of thirteen inches.

—The fifteenth annual meeting of the Wisconsin academy of sciences, held at Madison from Dec. 29 to Dec. 31, was unusually well attended. The academy expects to have suitable rooms assigned it in the capitol, on the completion of the additions to that building, in which its library and collections can be properly placed. The latter has become doubly valuable since the destruction of the scientific collections of the

state university, as it contains the only complete set of the Wisconsin rocks and fossils collected by the State geological survey. The sixth volume of the Transactions of the academy is nearly through the press, and will soon be distributed.

— The 'stately procession' of quarto volumes issuing from the census office has recently been increased by the addition of vols. ix. and x. The former consists of the report of Prof. C. S. Sargent upon the forests of North America (exclusive of Mexico). The six hundred and twelve pages of the report are divided into three parts. Part i., relating to forest-trees, sketches the general distribution of forests and of arborescent species and genera, while the great bulk of the chapter is devoted to an exhaustive descriptive catalogue of the forest-trees of the region. Part ii. treats of the economic qualities of the principal woods, their specific gravity, fuel value, strength, etc. Part iii. is devoted to the lumber industry, treating incidentally, also, of many minor points connected more or less directly therewith, such as forest-fires, the pasturage of woodlands, etc. The maps in the report, of which there are no less than thirty-nine, illustrate the different degrees of density of the distribution of woodland, the distribution of merchantable timber, and the areas deforested, the extent of forest-fires during the census year, and the character of the fuel used in various parts of the country. The report is accompanied by an atlas of cumbrous size, containing thirteen maps of the United States and of North America, illustrating the distribution of forests in general, and of a number of genera of forest-trees; showing the position of forest, prairie, and treeless regions, and the natural divisions of the North-American forests. Vol. x. contains three monographs bound together: 1°, 'On the production, technology, and uses of petroleum and its products,' by Prof. S. F. Peckham; 2°, 'The manufacture of coke,' by J. D. Weeks; and, 3°, 'Building-stones of the United States, and statistics of the quarry industry,' by George W. Hawes *et al.* The report upon petroleum is exceedingly full, comprising three hundred and one pages, illustrated by numerous cuts and maps. It is divided into three parts, the first of which relates to the history of the subject, the geology, geography, and chemistry of petroleum, and contains the statistics of production. The second is devoted to the technology of petroleum, and the third to its products and uses. The report upon coke (a hundred and fourteen pages) opens with the statistics of the industry, followed by descriptive matter relating to its extent and importance in the United States and in foreign countries, and closes with the chemistry and technology of the subject. The report is illustrated by numerous cuts. The report upon quarries and building-stones (four hundred and ten pages) opens with a discussion of general matters pertaining to the subject, followed by chapters upon microscopic structure and chemical composition of building-stones, and the methods used in quarrying. The statistics of the industry follow, accompanied by detailed descriptions of quarry regions. The succeeding chapter is devoted to the extent of stone-construction in the leading cities, in the course of which is found an admirable article upon stone-construction in New-York City, by Prof. A. A. Julien. This well-known authority makes a further contribution to the report in the form of a chapter upon the durability of building-stones in New-York City. The work is illustrated with eighteen heliotype plates from microscopic photographs of rock-slides, and thirty-two chromo-lithographs (by Bien & Co.) of polished rock-surfaces. These are among the finest specimens of the lithographic art which have yet been produced in this country.

— The bark Helen Isabel recently arrived at St. John, N.F. While in latitude 38° 51′ north, longitude 29° 55′ west, Dec. 18, a terrific earthquake was experienced, lasting fifteen minutes. The submarine roaring was appalling, and the vessel was shaken in every fibre. The weather was calm and fine at the time. This is of interest in connection with the recent earthquakes in Spain.

— The commander of the British steamship Bulgarian reports that on Dec. 29, in latitude 49° north, longitude 34° 30′ west, at two P.M., while the sea was smooth and the wind moderate from south and west, he ran through a regular bore. The water boiled and seethed. The surface of the bore was about two feet above the general level of the ocean, and its extent about six miles long and from three to five miles wide, moving to the north-east. This is a very unusual phenomenon for such a place.

— In a report by the committee on the metric system of weights and measures, of the Boston society of civil engineers, attention is called to a number of instances in which the metric system is now used in this country. A number of makers of surveyors' tapes now graduate them on the metric system, as well as in feet and inches. About the only case reported of the introduction of the system for trade purposes is that of the Minneapolis flour-mills, which put up flour in bags containing fifty and a hundred kilos, for export to Europe.

— A *Journal of mycology* is announced by W. A. Kellerman of Manhattan, Kan., under the charge of J. B. Ellis of Newfield, N.J., and W. A. Kellerman, as editors. It is proposed to make the journal a monthly of from twelve to fifteen pages. It is to be hoped that the undertaking may prove successful; but it is very doubtful whether there can be need for so special a journal, when we consider that it will be supported solely by American students.

— We have received a copy of an interesting statistical pamphlet, "Die stundenpläne für gymnasien, realgymnasien und lateinlose realschulen in den bedeutendsten staaten Deutschlands, zusammengestellt von G. Uhlig" (Heidelberg, *Winter*, 1884). The tabular views of each group of schools are first separately given; summaries compare in tables the number of hours given to each topic in the schools of the various states of the German empire; and seventeen closely printed pages of *resultate* discuss these statistics with great completeness, and yet with great condensation. It will be seen that we have here an

excellent means for finding what topics German schools of the various classes actually teach, and how much they teach of each topic to pupils of any given age. The accuracy of the pamphlet is vouched for by competent authority; and the whole may be warmly commended to every one who is engaged in the study of problems connected with elementary education. The general reader, also, will be interested in the suggestions that he can get at a glance from these tables concerning the character of German elementary education. Quotation is, on the whole, hardly possible where a book is already a model of condensation, and we shall not attempt it. But let no one pretend hereafter to pass judgment on the work of German schools without using the elementary facts as they are here presented.

— The Anthropological society of Washington has adopted the plan of so arranging its programme as to devote an entire evening to a single subject, or to subjects closely related. This adds much to the interest of meetings. The place of meeting in Columbian university building is convenient, and the attendance has lately been larger than ever before in the history of the society. On Jan. 20 is the annual election of officers.

— Sir William Thomson's lectures on molecular dynamics are now ready for delivery to subscribers. An edition of three hundred copies has been printed, and of these only seventy-five remain for sale. The volume contains three hundred and thirty-six pages in all. Sir William Thomson has sent, since his return to Europe, several pages of additional matter, which is given with the lectures. An index and bibliographical note have also been added.

— In a speech before the African conference at Berlin last November, Mr. Stanley, according to *Le mouvement géographique*, said, "The Kongo is, with one exception, the greatest river in the world, with the most extensive valley. No region, either equatorial or tropical, can rival it in fertility. There are great empires of natives, and republics, such as Uganda, Ruanda, Unyoro; a country of broad plains for the grazing of cattle, as the Masai Land. There are numerous deposits of gold and silver, and rich mines of copper and of iron. There are beautiful forests which produce woods of an inestimable value, India-rubber in inexhaustible quantities, gums, and precious spices. There pepper and coffee are grown. There are tribes susceptible of appreciating the advantages of civilization, provided they are protected against the attacks of brigands and the ambuscade of the slave-trader. In my opinion, these facts are sufficient to justify my proposition to define, by means of the easily ascertained limits I have proposed, the frontiers of the free commercial territory of equatorial Africa, and to guarantee the freest possible access as well from the east as from the west."

— The advice to explore the high peaks and little-known parts of the Caucasus, given to experienced Alpine travellers in the early part of the year, by D. W. Freshfield, in the *Alpine journal*, has already borne some fruit. The well-known Hungarian mountaineer, Moritz v. Déchey, was the first on the ground. On the 24th of July, he, in company with two Swiss guides, made the first ascent of the 15,500-feet-high peak of Adni Choch, after overcoming great difficulties. On the 23d of August followed the ascent of the highest western peak of the Elbrus, which had been previously accomplished but once, — by Grove in 1874. During the journey, which led from the Ardon valley, over the high passes of the Elbrus, photographs and measures of elevation, which have hitherto been entirely wanting from the central Caucasus, were taken.

— Dr. Brieger of Berlin has made a special study of the ptomaines; i.e., the chemical poisons resulting from the action of bacteria upon animal substances. By digestion of albuminous bodies in gastric juice, he obtained a toxic substance, to which he has given the name peptotoxin. From putrid flesh he obtained two bodies, — one a diamin of the composition $C_5H_{14}N_2$, a body which he calls neuridin, which, when pure, is devoid of toxic action; and, as the second product, neurin, a substance with decided poisonous properties, antagonized by atropin. By the putrefaction of fish-flesh, another diamin was discovered, ethylendiamin, — $C_2H_4(NH_2)_2H_2O$, — a powerful poison; also muscarin, and a body which Brieger provisionally calls gadinin ($C_7H_{17}NO_2$). It is interesting to note that the character of the ptomaines formed, depends somewhat upon the character of the material used: thus, neurin is found only in the putrefaction of flesh; while muscarin, ethylendiamin, gadinin, and triethylamin are specific products of fish putrefaction, and dimethylamin of gelatin putrefaction. His work also indicates that the ptomaines should be divided into the poisonous and non-poisonous.

— The *Journal of the Society for psychical research* for November (for circulation among members only) contains an interesting account of Professor Barrett's visit to America, and the steps which led to the formation of an American society of similar name. Professors Bowditch, Fullerton, Stanley Hall, James, Carvill Lewis, and Pickering have been chosen corresponding members of the London society.

— Among recent deaths we note the following: Hermann Kolbe, professor of chemistry at Leipzig, Nov. 26, at the age of sixty-six; Dr. Heinrich Bodinus, director of the Berlin zoölogical gardens, at Berlin, Nov. 23, at the age of seventy-one; Dr. Karl von Vierordt, at Tübingen, Nov. 22, at the age of sixty-seven; Henri Lortique; A. W. Thienemann at Zangenberg, Nov. 5, at the age of fifty-four; Alfred Brehm, at Renthendorf, Nov. 11, at the age of fifty-five; Professor Edmund Tömösvary, at Deva, Aug. 18; Charles Tulasne, at Hyères, Aug. 21, at the age of sixty-eight; Richard Townsend, professor of mathematics at Dublin university; Arthur Henninger, chemist, at Paris, in November; Dr. Thomas Wright, at Cheltenham, Nov. 17; Dr. W. von Wittich of the University of Konigsberg, Nov. 21; Henry Lawrence Eustis, professor of engineering at Cambridge, Mass., Jan. 11, in his sixty-sixth year.